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RECENT TRENDS IN MINING ACTIVITY IN
THE UPPER PENINSULA OF MICHIGAN AND
THEIR EFFECT ON REGIONAL DEVELOPMENT

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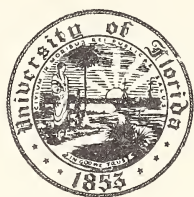
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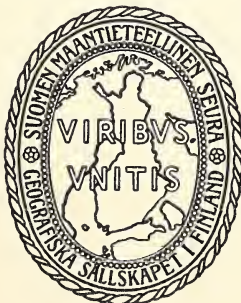
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Stig Jaatinen and Kalevi Rikkinen

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ABSTRACT

This study deals with the latest trends in iron and copper production in the Upper Peninsula of Michigan and their effect on the development of population and the economy in general. In the Houghton-Keweenaw region, where native copper has been found, production has fallen markedly since 1950 because of the dwindling of rich ores. The situation has been redeemed to some extent by the start of mining in Ontonagon, where copper sulphide (1.2 % copper) has been found. Michigan copper production as a whole has lost its former status and now represents only some 6 % of United States output. A similar development has occurred in iron production. The yield of rich ores in the study area has decreased, and poorer ores have been taken into use. In absolute terms output has remained much the same, but the number of workers has fallen considerably. The interdependence of mine output trends and the development of population and the economy are studied here by the method of cross classification. Between the development of mine output and population a clear dependence can be shown, but between mine output and general economic development the dependence seems less pronounced.

I. INTRODUCTION

From the mid-19th century onward the Upper Peninsula of Michigan has been important in the iron and copper production of the United States. Ore bodies were abundant and the ores exceptionally rich, while the Great Lakes supplied an admirable transport route to industrial centres. The last 15—20 years have brought a decisive change, however. Iron and copper mining have been through a serious crisis caused simply by the exhaustion of the rich ores. In order to redeem this state of affairs efforts have been made to guide production towards the use of poorer ores.

The present study first examines the latest trends in iron and copper production in the Upper Peninsula of Michigan, and then attempts to answer the following questions:

The author was a visiting scholar in the Department of Geography, Michigan State university, during 1970 sponsored by the American Council of Learned Societies.

1. To what extent have trends in mining affected recent population development in the region?

2. To what extent have these trends affected recent economic development in the region?

This study relies on written and statistical material collected by the author from the library of Michigan Technological University at Houghton. This library is considered one of the best in the United States on the subject of mining production. In the search for an answer to the above questions counties with mining activity are compared to counties without it, using mainly the simple technique of cross classification. In geography this method is rarely applied, particularly in comparison with sociology, but in the present study the character of the material and, especially, the fewness of the units of observation (counties) prevent the use of more advanced statistical methods. Information on units smaller than counties is not published, moreover, since mining companies naturally wish to preserve their business secrets as far as possible.

II TRENDS IN COPPER PRODUCTION

The copper ore bodies of the Upper Peninsula of Michigan are found in the counties of Houghton, Keweenaw and Ontonagon (Fig. 1). The Houghton and Keweenaw ore is mainly native copper which occurs stratiformly in its host rock, conglomerate or amygdaloidal basalt (White 1968, p. 314). Ontonagon ore, on the other hand, is copper sulphide with an average copper yield of only 1.2 % (Ensign et al. 1968, p. 464).

Mining in the Houghton-Keweenaw region started in the mid-19th century. Capital came chiefly from outside Michigan, from Boston and Philadelphia in particular. Towards the end of the century these original shareholders began to gather enormous profits, because by 1880 the region was producing some 90 % of United States copper (Northern Michigan University 1965, p. 7). From the 1880s onward, however, this percentage began to fall as the open-pit mines of the Rocky Mountains rapidly increased their output. In absolute terms the highest production figure in Houghton-Keweenaw was achieved in 1916, but since then output has steadily declined. Only at the end of the 1920s and during the second World War has a slight increase been recorded (Henderson—Krueger 1965, p. 89). Since the easily worked seams near

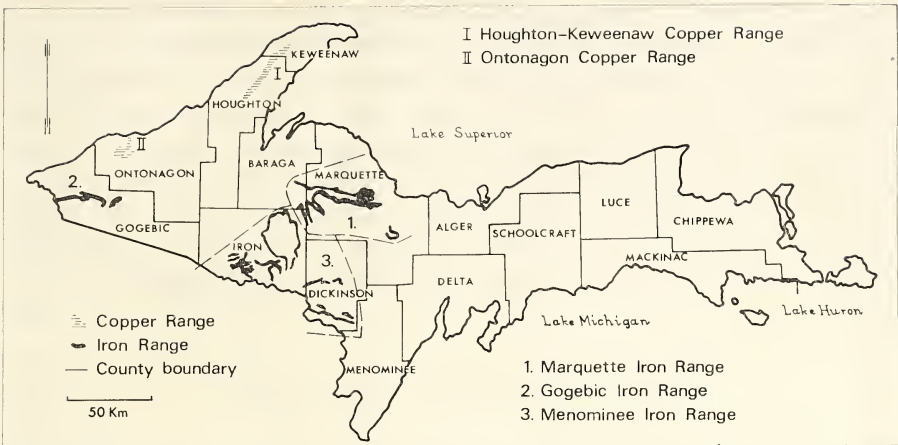


Fig. 1 The Upper Peninsula of Michigan: copper and iron districts, also counties
Source: Senninger 1970, p. 36.

the ground surface have been exhausted, output has lessened continuously.

Abundant deposits of usable copper are known to be still present in the Houghton-Keweenaw region, but they are at some of the deepest levels in the world. There is no question of open-pit mining. The application of modern technique to the extraction of these ores makes them at the moment too expensive in comparison with current world market prices. Open-pit copper, especially from Africa and South America, is keeping the world market price low. It is unlikely, however, that any further extensive deposits will be found for which open-pit mining is possible (cf. Boyd 1961, p. 13). Accordingly, three companies still operate in the Houghton-Keweenaw region: Calumet & Hecla, The Quincy Mining Company and the Copper Range Company. These firms are studying possibilities for the resumption of large-scale copper mining despite the depth of the ores (cf. Houghton County Comprehensive Plan 1967 p. 7).

The copper sulphide ore of Ontonagon has been known for at least a century, but because of its low copper yield the deposit had no practical significance until the ore of the Houghton-Keweenaw region was exhausted. A final incentive to the start of comprehensive mining activity in Ontonagon was the Korean war, which raised the price of copper in the early 1950s. The Copper Range Company founded a

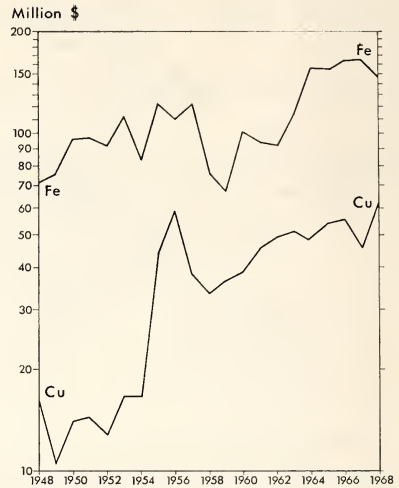
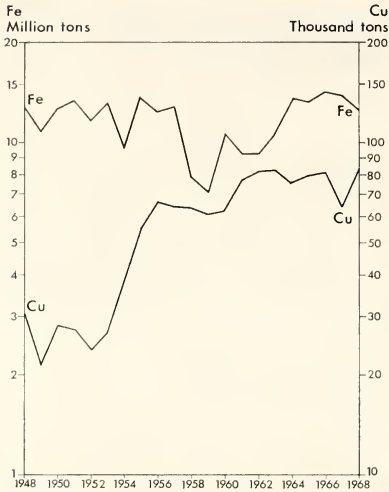


Fig. 2. (left) Michigan copper and iron production 1948—1968. Cu = copper (thousand tons), Fe = iron (million tons). Source: Minerals Yearbook 1949—1969.

Fig. 3. (right) Michigan copper and iron production value 1948—1968 in millions of dollars at 1968 dollar rate according to industrial wholesale price index. Cu = copper, Fe = iron. Source: Minerals Yearbook 1949—1969.

subsidiary, the White Pine Company, to mine in Ontonagon, and the State guaranteed the price of the ore (Henderson—Krueger 1965 p. 89). On investigation the copper sulphide resources of Ontonagon proved to be twice as large as was first surmised (Garrison 1966 b, p. 3). It is calculated that at the present rate of output the ore reserves will suffice for about a hundred years (Ensign et al. 1968, p. 464). The Ontonagon mines, like those of Houghton-Keweenaw, are shaft mines in which ore extraction is not particularly economical. But the working of such mines is unaffected by seasonal changes and, as a rule, by fluctuations of weather.

The curve in Fig. 2 shows the development of copper production for the whole of Michigan in absolute terms, while Fig. 3 shows the monetary value of the ore with inflation allowed for. It will be observed that copper production and its monetary value had declined to a very modest level by about 1950. This was due to decreased production in the Houghton-Keweenaw region. The start of new mining in Ontonagon redeemed the situation at first, but in the later 1950s no further rising trend was apparent in Michigan production as a whole.

In the period 1960—75 it is estimated that the yearly increase in Ontonagon merely balanced the decrease in Houghton-Keweenaw. Production thus remains at about the same level, representing at present only some 6 % of the United States total (Henderson—Krueger 1965, p. 88). This is a modest percentage compared especially with the end of last century and the early decades of the present century. Michigan copper production has lost its former status. The reasons for this are the exhaustion of the ore resources, the increased costs resulting from this and the cheaper ores available from other regions (cf. Davis 1964, p. 201).

III TRENDS IN IRON PRODUCTION

In the Upper Peninsula of Michigan iron ore was discovered in the 1840s. The ore bodies occurred in three ranges: Marquette, Menominee and Gogebic (Fig. 1). None of these is comparable in production scope to the Mesabi range in Minnesota, which, it is estimated, yields over 70 % of the iron ore of the Lake Superior region (Marsden 1968, p. 493).

The Marquette range is the principal iron ore district of the Upper Peninsula. It stretches from Marquette county to the eastern portion of Baraga county and has the advantage of a situation close to the ore-shipping ports of Lake Superior and thus to the ore markets. The biggest operator in this range is The Cleveland Cliffs Iron Company, which has its own railways, ore ships and by-product plants. These possessions have lowered production costs and also, as a matter of course, advanced the exploitation of the ore reserves (cf. Goodman 1949, p. 191).

Iron mining in the Marquette range began on a commercial basis in 1852. At first only the rich ores near ground surface were extracted, but by the 1880s the bulk of output was being obtained from shaft mines. In 1949 the Marquette situation was still so favourable that the lowest iron content of the ore extracted was 57 % (Goodman 1949, p. 192). In the 1950s, however, the production of rich ore for direct shipment was falling so sharply that a gradual shift was necessary to the use of jasper ore, which contains about 25 % of iron (cf. Anderson 1968, p. 508).

The Gogebic iron ore district is a range some 30 km long and at most 5 km wide. It begins with the Castile mine east of Wakefield, and ends with the Atlantic mine on the Wisconsin side. Mining started

on a commercial basis in 1881. The region achieved its highest iron ore production in 1919, but a steady decrease followed. During the 1960s output ceased altogether. In the Gogebic region the use of ores with a lower iron content has not been started, though the possibilities have been studied (Holmio 1967, pp. 199—200).

The Menominee range is situated partly in Dickinson county and partly in Iron county. A further small section is in Florency county, Wisconsin. Ore was first found during 1849 in southern Dickinson county, where production started in 1877; it ceased in 1959, however, when the ore was exhausted. In southern Iron county iron ore was discovered in 1851, production started in 1882, and in 1966 five mines were still in production. In central Dickinson county during the period 1882—1913 a small quantity of rich iron ore was produced, and in 1959 the use of poorer ore was started by a beneficiation process which has continued till the present. In the Menominee range a total of 96 mines have been active, about half of them in Iron county. In the mid-1960s six remained.

Viewed as a whole, the production in Michigan of rich iron ore for direct shipment was at its height in the 1910s and 1920s (Dutton—Zimmer 1968, p. 540). The utilization of rich ore alone continued until the 1950s (Keegan—van Tassel 1962, p. 7). Thereafter the exhaustion of ore reserves caused a great change not only in Michigan but throughout the United States. In 1950 U.S.A was still producing some 40 % of the world's iron ore, but by the end of the decade the proportion had fallen to a mere 14 % because of the exhaustion of rich ore deposits. During the same decade it was necessary to increase imports of iron ore by no less than 400 % (Keegan—van Tassel 1962, p. 7). In the ten years 1955—1965 the output of rich iron ore for direct shipment in Michigan fell from 14 to 7 million tons, i.e. to half the previous figure (Marsden 1968, p. 493). The 1950s were in fact the most critical period for iron production in the Upper Peninsula of Michigan. Numerous marginal mines had to be closed when operation became unprofitable, and at best work was continued in the expectation of a change in market prices.

The exhaustion of rich ores during the 1950s led to the development of a beneficiation process for ores of lower iron content. This has brightened production prospects again. From 1955 to 1965 the output of such iron concentrates in Michigan increased from 174,000 tons to 7,000,000 tons (Marsden 1968, p. 493). The beneficiation process was

adopted in the Marquette district of the Upper Peninsula from the Mesabi range in Minnesota, where it had been applied considerably earlier. Work is now performed on surface terraces in open-pit mines by stripping off the rocky overburden, which reduces the cost to about one seventh of what it would be in shaft mines. The process through which ore with a relatively low iron content must pass is long and complicated. Foreign matter is removed from the fine-ground mass partly by chemical and partly by physical means. The process is hampered by the non-magnetic character of the hematite-jasper ore in Michigan. The end result is a grey, floury iron concentrate which was formerly compressed into briquettes but is now pelletized (cf. Garrison 1966 a, p. 8). During 1965 over 70 % of production in the Marquette range was the result of concentration (Anderson 1968, p. 508).

The development of Michigan iron production largely resembles that of copper. Production of rich ores decreased, and poorer ores were taken into use. Since the second World War Michigan iron production has remained fairly constant in absolute terms. Mines and workers have both declined numerically, but total income from ore has grown, especially in the 1960s, because of a price rise (cf. Figs. 2 and 3). The remaining iron ore reserves of the Lake Superior region are estimated at 50 billion tons with an iron content of 25—45 %. In view of present technical requirements and price formation only a part of this ore mass can be economically extracted (cf. Marsden 1968, p. 493).

IV TRENDS IN MINING PRODUCTION AND POPULATION DEVELOPMENT

In 1960 some 12 % of skilled workers in the Upper Peninsula of Michigan were earning their living by iron and copper mining (Rodd-Henderson 1962, p. 49). This percentage, however, does not reflect quite truly the importance of mining to the population and economic life of the region, because according to some estimates as many as six service personnel outside the mine are needed for every miner (Davis 1964, p. 223).

As already noted, great fluctuations have taken place in the iron ore production of the Upper Peninsula over the last twenty years, but if a general view is taken production has remained fairly constant. The monetary value of production, on the other hand, has grown

because of the higher price, even with inflation taken into account (Figs. 2 and 3). Employment figures have moved in the opposite direction: the number of iron miners in the Upper Peninsula of Michigan is declining. This is an observation of great importance, because the employment figure may be taken as a measure of the social significance of industrial activity. From 1950 to 1960 the numbers engaged in iron mining within the study region fell no less than 25 %, a total of 2,080 persons. In 1950 the figure was 8,174 and in 1960 it was 6,094 (Rodd-Henderson 1962, p. 50). The years 1950—53 were comparatively favourable thanks to the Korean war, but the setback which followed towards the end of the 1950s was all the stronger. In 1963 the figure fell as low as 3,586. This was followed by a slight improvement but no decisive rise. The number of workers per ore production unit required in open-pit mines is considerably smaller than in shaft mines (cf. Northern Michigan University 1965, p. 71). As mechanization increases the productivity of work, the amount of money remaining in the locality grows relatively less and less, »capital predominance» increasing at the expense of »labour force predominance». As explained earlier, the capital for mine working came chiefly from outside the Upper Peninsula of Michigan, and profits were naturally directed to the same source.

Unfortunately, no annual data are available from counties on the numbers employed in mining, so the development of county population must be examined in relation to that of mining production. In absolute terms the growth of iron mining has been most notable in Marquette county, where the biggest employer of the Upper Peninsula is in operation. This is the Cleveland Cliffs Iron Company, whose employment roll was calculated at some 3,000 in the mid-1960s (Garrison 1966 a, p. 8). Marquette county shows the clearest population growth of the whole study region (cf. Fig. 4). The diagram may easily give rise to a faulty interpretation, because Marquette county contains a town of the same name which has become the most rapidly developing centre in the Upper Peninsula. Though mining has been a powerful influence on the birth and development of the town of Marquette, other factors have certainly played a part also.

Another iron mining county where the development in iron production has been strong, especially in a relative sense, is Dickinson. Its population has declined, however, during the last fifteen years. Simple cross-classification in Fig. 4 indicates, however, that this decline has been distinctly smaller than in Gogebic, Iron and Baraga counties, in

	Population increased	Population decreased 1-10 %	Population decreased over 10%
Mine production value increased	Marquette	Dickinson Ontonagon	
Mine production value decreased			Gogebic Iron Baraga Houghton Keweenaw
Mine production has no great significance	Chippewa Delta Mackinac	Menominee Schoolcraft	Alger Luce

Fig. 4. Cross classification: mine production development (average of years 1953—56 and 1965—68) and population development (1953 and 1968). Sources: Minerals Yearbook and Michigan Population Handbook.

all of which iron ore production has decreased absolutely. The situation is worst of all in Gogebic, where in 1965, for instance, the closure of the Genewa-Newport mine brought unemployment to no less than 265 workers. In the same year the Hiawatha mine in Iron county also closed, depriving 235 of work.

In general terms, cross classification of Fig. 4 seems to indicate a causal interaction between the development of iron mining and population.

As for copper production and population development, it should first be noted that the start of mining in Ontonagon in the mid-1950s caused a rise of 524 in copper mine employees during the period 1950—1960 in the Upper Peninsula of Michigan (in 1950 the figure was 2209 and in 1960 it was 2733). This represents an increase of almost a quarter (Rodd—Henderson 1962, p. 50). Despite the rising trend in copper production no sharp rise in the number employed can be expected, because production per worker is rising more sharply still as a result of mechanization. In other words, total production must rise very considerably before it is clearly reflected in the number of employees (Northern Michigan University 1965, p. 8 and Houghton County Comprehensive Plan 1967, p. 7).

Copper mining counties can be placed in two groups regarding development. One consists of Ontonagon county alone, the other of Houghton and Keweenaw counties. In Ontonagon mining and the number of its employees increased substantially after the mid-1950s. County population has been slightly on the decline nonetheless, possibly for the reason that skilled miners who lost their employment in Houghton and Keweenaw counties go to work in Ontonagon mines. The distance is not too great for commuter traffic. In Houghton and Keweenaw copper production has clearly fallen in the last fifteen years, and population decline has been great, in fact over 10 %. On the above grounds cross classification of Fig. 4 would seem to indicate a causal relation between the development of copper production and population.

The significance of mining production for population development is also reflected in the age of dwellings in mining communities. In the Houghton-Keweenaw region according to the 1960 census no less than 95 % of all residential buildings in the mining town of Houghton were erected before 1939. In the neighbouring town of Hancock the corresponding figure was 93 %, and in Ironwood, main centre of the iron ore region in Gogebic county, 89 %. In the more rapidly growing town of Marquette, on the other hand, 71 % of dwellings were built before 1939. A further example, from Mackinac county: alongside a bridge of the same name which connects the Upper and Lower Peninsulas lies the tourist centre of St. Ignace, where the corresponding figure is only 48 % (Comprehensive Planning for the Upper Peninsula of Michigan, vol. II, 1967, Table H I).

V TRENDS IN MINING PRODUCTION AND GENERAL ECONOMIC DEVELOPMENT

When the interrelation of mine production trends and general economic development is examined, it is possible to measure economic development in various ways. The capital resources of a region are a fact of great economic importance. They are best evaluated by the volume of bank deposits (cf. Comprehensive Planning for the Upper Peninsula of Michigan 1967, vol. I, 11—24). Fig. 5 shows the cross classification between the development of mine production and that of bank deposits. In Dickinson and Ontonagon counties, where mining has increased, the volume of bank deposits has also increased most. In Marquette

	Bank deposit development 1958 - 1968		
	over +100 %	+60 - +100 %	below +60 %
Mine production value increased	Dickinson Ontonagon	Marquette	
Mine production value decreased	Baraga	Houghton	Gogebic Iron Keweenaw
Mine production has no great significance	Mackinac Schoolcraft	Alger Chippewa Delta	Menominee Luce

Fig. 5. Cross classification: mine production development (as Fig. 4) and bank deposit development 1958—1968 (inflation not allowed for). Sources: Minerals Yearbook and Michigan Statistical Abstract 1960 and 1970.

	Annual per capita income development 1957 - 68		
	over +115 %	+100 - +115 %	below +100 %
Mine production value increased	Ontonagon		Dickinson Marquette
Mine production value decreased	Baraga	Houghton Iron	Gogebic Keweenaw
Mine production has no great significance	Chippewa Luce Mackinac	Delta Menominee Schoolcraft	Alger

Fig. 6. Cross classification: mine production development (as Fig. 4) and annual per capita income development 1957—1968 (inflation not allowed for). Sources as Fig. 5.

county, on the other hand, the development of bank deposits is only a moderate despite rising mine production. The same is true of Houghton county, but Baraga county belongs to the class of most rapidly rising bank deposits although mine production is falling. The volume of such production in Baraga is small, however, compared with other mining counties, so that no great stress can be laid on this isolated case. At all events no less than three counties in which the absolute value of mining has decreased most — namely Gogebic, Iron and Keweenaw — are also found in the weakest category of bank deposit development. As a general conclusion from the cross classification presented it may be said that at least a weak correlation exists between the development of mine production and that of bank deposits. This is understandable for the further reason that mining companies keep deposits in local banks specifically for the payment of wages even when the main financing is from outside the district concerned.

On the evidence of Fig. 6 the correlation between mine production and annual per capita income seems extremely weak, especially in counties where the absolute value of mining activity has increased. The correlation between mining decrease and slow growth of annual per capita income, on the other hand, seems clearer (for reasons already mentioned, no great stress can be laid on the placing of Baraga county in the cross classification). Similarly, rather weak is the strength of the correlation between mine production development and retail sales development (Fig. 7) on the one hand, and between mine production development and change in the value of services (Fig. 8) on the other. Particularly in Ontonagon, where the absolute value of mining production has risen substantially in the last fifteen years, the development of retail trade and services appears to have remained weak. The main reason for this may be that a considerable number of miners working in Ontonagon live in the old mining districts outside the county, and naturally conduct their transactions there.

In view of the above it seems on the whole that a dependence exists between the development of mining production and that of population, but that the correlation between economic and mine production development is less strong. When results of analysis are examined it must be remembered, however, that the county may be too large a unit of examination, but data on smaller areas are not available. Nevertheless, further reasons than the waning or stagnation of mining production

	Retail sales development over +33 %	development +22 - +33 %	1954-1967 below +22 %
Mine production value increased	Dickinson Marquette		Ontonagon
Mine production value decreased	Baraga	Houghton Iron	Gogebic Keweenaw
Mine production has no great significance	Delta Mackinac	Chippewa Luce Schoolcraft	Alger Menominee

Fig. 7. Cross classification: mine production development (as Fig. 4) and retail sales development 1954—1967 (inflation not allowed for). Sources as Fig 5.

	Monetary value of services development over +100 %	development +70 - +100 %	1954-1967 below +70 %
Mine production value increased	Marquette Dickinson		Ontonagon
Mine production value decreased		Gogebic Iron Keweenaw	Baraga Houghton
Mine production has no great significance	Chippewa Delta Mackinac	Alger Luce	Menominee Schoolcraft

Fig. 8. Cross classification: mine production development (as Fig. 4) and monetary value of services development 1954—1967 (inflation not allowed for). Sources as Fig. 5.

must be sought for the weakness of economic development in the Upper Peninsula of Michigan. They may be listed as follows:

1. The distance of the Upper Peninsula of Michigan from the main industrialized urban areas of Michigan and the Middle West in general. Rikkinen (1968 a, 1968 b, 1969 and 1970) in several studies of the Middle West has shown the prime importance of the distance factor for population development and, as an evident result, for economic development also.

2. Agricultural development has been on the wane. An exceptionally large section of the population of the Upper Peninsula has earned its living by farming. In the twenty years following the war, the income from dairy farming fell by more than 20 %, taking inflation into account (Yli-Jokipii 1970, p. 114). Traditional potato growing is also declining. Because of a short growing season and poor soils some other type of agrarian production which is able to compete is hardly possible in this region. If all counties of the Upper Peninsula are used as material to calculate the correlation between the development of population and that of incomes derived from agriculture, the correlation coefficient becomes as high as + 0.67, a significant result despite the fewness of the observation units. The waning of agriculture is largely explained by the distance from consumption centres which is mentioned in Section 1.

3. The steady decline of forestry in the 20th century. In the period 1870—1930 the pine forests of the region were exhausted. At the same time the utilization of deciduous trees began. Thus the forests have been continuously used without any extensive conservation-measures. As a consequence of this destruction of the natural timber resources production of wood in the Upper Peninsula today is only on third of what it was in the 1920s. (cf. Weisbrod 1965, p. 135 and Northern Michigan University 1965, p. 86).

4. All the main livelihoods of the Upper Peninsula, farming, forestry, mining, tourism and building are markedly seasonal. Migration has increased greatly because of seasonal unemployment.

VI FINAL COMMENT

The Upper Peninsula of Michigan has long held the status of a source of raw material. The main natural resources, ores and forests, have been almost exhausted. This remote region of study cannot compete

in agricultural production with more southernly farming areas which are struggling with problems of over-production. If the iron and steel industry had been sited in accordance with ore, not coal deposits, the Upper Peninsula would surely have developed otherwise. The Great Lakes have provided an easy transport route for ores and timber, raw materials of the Upper Peninsula. At the same time they have cut off the region from economic contacts. Besides the Appalachian region the Upper Peninsula of Michigan, together with other northern border areas of the Middle West, is nowadays one of the worst problem districts of the United States.

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